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FINAL REPORT

May 15, 1995

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Future of Major Federal Laboratories

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About the National Science and Technology Council

President Clinton established the National Science and Technology Council (NSTC) by Executive Order on November 23, 1993. This cabinet-level council is the principal means for the President to coordinate science, space, and technology policies across the Federal Government. NSTC acts as a "virtual" agency for science and technology to coordinate the diverse parts of the Federal research and development enterprise. The NSTC is chaired by the President. Membership consists of the Vice President, Assistant to the President for Science and Technology, Cabinet Secretaries and Agency Heads with significant science and technology responsibilities, and other senior White House officials.

An important objective of the NSTC is the establishment of clear national goals for Federal science and technology investments in areas ranging from information technologies and health research, to improving transportation systems and strengthening fundamental research. The Council prepares research and development strategies that are coordinated across Federal agencies to form an investment package that is aimed at accomplishing multiple national goals.

To obtain additional information regarding the NSTC, contact the NSTC Executive Secretariat at 202-456-6100.

About the Office of Science and Technology Policy

The Office of Science and Technology Policy (OSTP) was established by the National Science and Technology Policy, Organization, and Priorities Act of 1976. OSTP's responsibilities include advising the President in policy formulation and budget development on all questions in which science and technology are important elements; articulating the President's science and technology policies and programs, and fostering strong partnerships among Federal, State, and local governments, and the scientific communities in industry and academe.

To obtain additional information regarding the OSTP, contact the OSTP Administrative Office at

202-395-7347.

National Science and Technology Council
Interagency Federal Laboratory Review
Final Report
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BACKGROUND

A Presidential Review Directive (PRD/NSTC-1) of May 5, 1994 established the Interagency Federal Laboratory Review, focusing upon the government's three largest laboratory systems, those of the Department of Defense (DOD), the Department of Energy (DOE), and the National Aeronautics and Space Administration (NASA).

These three laboratory systems account for at least one-fifth of the entire federal investment in research and development (R&D) -- approximately $15 billion out of a total of about $70 billion. They are full of human talent and rich in facilities; they have many responsibilities in common; and they are all reexamining their roles, missions, and responsibilities in meeting the evolving needs of the Nation after the end of the Cold War.

Adding urgency to the task of reexamination is the necessity to change the way government works -- to create a government that works better and costs less.
The National Performance Review of 1993, led by Vice-President Gore, has resulted in great improvements, both in lower costs and better service. A second round, again under the Vice-President's leadership, is achieving still more. A review of the government's three biggest laboratory systems aimed at realizing greater service to the Nation at lower cost is an essential piece in the enterprise of reinventing government.

In 1993 and 1994, each of the three agencies undertook a review of its own laboratory system. For DOD, the review was done internally in the Office of the Director of Defense Research and Engineering (DDR&E), in connection with Round Three of the military's Base Realignment and Closure process; Dr. Craig Dorman, retired admiral, directed the review. The Secretary of Energy and the Administrator of NASA each appointed independent external task forces to conduct reviews of their laboratories. Robert Galvin, former Chief Executive Officer and current Chairman of the Executive Board of Motorola, chaired the DOE review; Dr. John S. Foster, Jr., former director of Lawrence Livermore National Laboratory and former DDR&E, chaired the NASA review. In addition, DOE prepared for the National Science and Technology Council (NSTC) a report responding to the recommendations of the Galvin Task Force.

The future of these three major laboratory systems has important implications for the nation's entire research enterprise. Therefore, under authority of the PRD, the NSTC initiated an interagency review that was structured to guide, build upon, and integrate the individual

agency reviews. In preparing this report, the NSTC has considered the reports of the three reviews and the DOE response. They are, in large measure, the basis for NSTC's findings and recommendations. But NSTC has, of course, exercised independent judgment, and in some cases this report diverges from or pushes farther the findings and recommendations of the individual reports.

PRD/NSTC-1 identified five areas of evolving national need: fundamental science, national security, environmental protection and cleanup, industrial competitiveness, and space exploration and aeronautics. The core purpose of the NSTC review has been to evaluate the effectiveness of the laboratories in responding to these national needs, and to identify ways they can contribute their best to these needs with maximum efficiency.

This report presents NSTC's findings and offers recommendations for enhancing the effectiveness and efficiency of the federal government's investment in its three largest laboratory systems.

FINDINGS

Contributions of the Laboratories to National Needs

The DOD, DOE, and NASA laboratory systems all play essential roles in research and development that serves the Nation's needs.

The fundamental responsibility for DOD laboratories is to conduct science and technology programs in support of national security. The labs can and do make important contributions to other national needs, but only as secondary to the paramount task of meeting national security requirements.

The core missions for NASA's Centers are to assist in the exploration of space and the development of space for human enterprises; to further scientific knowledge of Earth, the solar system, and the universe; and to advance aeronautical, space, and related technologies.

The DOE laboratories support the Department's central missions in energy, environmental science and technology, national security, and fundamental science. The DOE laboratories also serve national needs through very substantial R&D for other federal agencies, primaily DOD.

A note about the energy mission: Although energy was not singled out as an area of national need in NSTC/PRD-1, it is at the core of what the department and the DOE labs do, and it is vital to the national security, environmental integrity, and economic welfare of the Nation. Present patterns of energy use affect the global environment, and will have still greater impacts as countries grow richer and increase their energy use. At the same time, there will be global economic opportunities in the 21st century for a U.S. industry that is able to offer clean, sustainable, and affordable energy technologies. As world oil resources, and U.S. dependence on oil imports, become more concentrated in the Mideast, alternative energy technologies will increasingly be a national security as well as an economic asset.

Each of the laboratory systems makes important contributions in multiple areas of national need.

Fundamental Science

The DOE and NASA labs are deeply integrated into the Nation's research in fundamental science.

NASA provides indispensable support for astronomy, astrophysics, the study and monitoring of the total Earth environmental system, and a number of areas in life science and materials science. Recent discoveries made by NASA's Hubble Space Telescope challenge

existing theories about the origin of the universe, and much of the knowledge of our own solar system -- including Planet Earth -- is due to NASA research. Interactions between the students and faculties of America's great research universities and NASA lab scientists are essential to advances in astronomy, astrophysics, space science, and earth science.

DOE has still broader scientific responsibilities, in support of its national security, energy, and environment missions, and in related fields of basic research. The DOE labs have a central role in the design, construction, and operation of large basic research facilities that support research in physics, chemistry, materials science, and certain areas of biology and earth science. These facilities -- mostly too large-scale for universities or industry to support -- serve as national centers, bringing together federal, industrial, and academic investigators for creative interactions at the frontiers of science. The recent discovery of the top quark (at the Fermi National Accelerator Laboratory) and the most recent Nobel Prize for Physics (for lab work on the use of neutron diffraction in materials studies) are examples of the essential contributions of the DOE labs to U.S. world leadership in high energy and nuclear physics and materials science.

The contribution of DOD labs to fundamental science is more specialized. Most of the department's basic research is executed in universities. Research in the DOD labs is mostly targeted at fields of particular significance to warfighting and the military aspects of national security.

National Security

As noted, the overriding mission of the DOD laboratories is national security. Although there are few if any technical constraints to other performers (industrial labs, universities) conducting R&D for the military -- indeed, DOD outsources most of its R&D -- there are compelling arguments for maintaining a quality DOD lab system. DOD labs are best able to translate between technological opportunities and the warfighters' needs, integrate technologies across life cycles and generations of equipment, respond rapidly to DOD needs, provide special facilities, and offer the necessary technical support to the services to make them smart buyers and users of technology.

DOE labs have made unique contributions to national security since the days of the Manhattan Project, in designing, developing, and maintaining nuclear weapons. Today, no new nuclear weapons are being designed in the United States, but the laboratories' nuclear weapons program remains essential to the Nation's defense. The task of DOE's three weapons laboratories (Los Alamos, Lawrence Livermore, and Sandia National Laboratories) is to ensure a safe, secure and reliable nuclear stockpile, despite cessation of nuclear testing, and to provide technical support in non-proliferation, counter-proliferation, verification, and intelligence. Competent performance of these tasks requires a connection between national security and fundamental science, and that connection is exceptionally strong -- perhaps uniquely so -- in the DOE weapons labs.

NASA contributes to national security in scientific and technical areas in both civilian and military aerospace. In a larger sense, NASA's major role in international aerospace -- especially in the international Space Station, together with Russia, Japan, Canada, and nine members of the European Space Agency -- contributes to national security by strengthening international stability.

Environment and Energy

Energy and environment are so closely interconnected in the mission and work of DOE labs that they should be considered together. Although fossil fuels will remain dominant well into the next century, greater energy efficiency and a sustainable supply of clean energy are essential for the long term, given the environmental impacts of present patterns of energy use. The R&D involved is so high-risk and long-term, and the payoffs are so great in terms of public benefits, that this is clearly an essential area for public-private collaboration and investment. DOE's applied energy research in efficiency, conservation, and renewable energy sources serves goals of environmental protection, from the scale of urban centers to Earth as a whole, and of national security and economic stability, by reducing this Nation's dependence on foreign oil.

Both DOE and DOD have enormous responsibilities for cleaning up pollution from weapons programs of the past. Both have the opportunity, in cleaning up their own pollution, to advance the science and technology of environmental remediation, as well as providing sites for tests and demonstrations of new technologies. DOE labs alone have the nuclear expertise to develop technologies to deal with high-level and mixed wastes.

The DOE labs can play a substantial role, in partnership with industry, in developing the emerging science and technology of "industrial ecology" -- a systems approach to designing environmental compatibility and resource conservation into industrial processes. The labs' capabilities in advanced manufacturing technologies, materials science and technology, and modeling and simulation of complex systems are valuable for this purpose.

NASA's Mission to Planet Earth Program is the major contributor to the U.S. Global Change Research Program, with research leading to a fundamental understanding of Earth's environment and climate changes. It is primarily a fundamental science program, but through continual enlargement of scientific understanding it contributes to the formation of better informed and timely environmental policy. DOE labs also have an important part to play in climate change research, using their outstanding capabilities in high-performance computing and modeling.

Industrial Competitiveness

NASA has a longstanding mission -- dating back to the founding of its predecessor agency in 1915 -- to support the performance of the aircraft industry. In particular, NASA facilities (such as wind tunnels and the Numerical Aerodynamic Simulator at the Ames Research Center) and NASA R&D that is coordinated with industry priorities have long been a factor in the performance of the U.S. aircraft industry -- one of our largest industrial sectors, and the one that consistently generates the Nation's biggest sectoral trade surplus. U.S. commercial ventures in space also owe much to NASA R&D.

DOE labs contribute to the advance of technologies relevant to a broad range of industrial sectors. However, industrial competitiveness is not a stand-alone mission of the labs, but is subsidiary to their primary missions in energy, environment, and national security. Partnerships with industry, properly designed to serve the central DOE missions, can also promote stronger performance by the private sector and U.S. economic growth. Laboratory-industry partnerships are of widest benefit to the U.S. economy when they involve industrial consortia with a well-developed agenda of generic and pre-commercial R&D (a technology road map). Although lab-industry partnerships have usually been viewed as transferring DOE-generated technologies to the private sector, the use of privately developed technologies to further DOE missions is equally important. Partnerships are a two-way street.

As with DOE labs, industrial competitiveness is not a central mission for DOD labs. However, most of the labs have technologies of interest to industry, and technology transfer is one of the labs' responsibilities. To meet military needs, DOD labs have developed technologies in a few sectors that are not only applicable to civilian needs but are more advanced than those in the parallel civilian sector. Two such sectors are Architecture/Engineering and Construction and Shipbuilding. Collaborative R&D with industrial partners in these areas is targeted first at meeting military needs but is also intended to strengthen an integrated civilian-military industrial base that can meet future defense needs for advanced technologies at affordable cost.

Space Exploration and Aeronautics

Obviously, space exploration and aeronautics is where NASA's contribution is greatest. NASA's ventures in human exploration of space are a matter of national pride, and NASA's space-related science research is of the greatest importance in understanding the solar system and the Universe. NASA's support of aeronautical science and technology, together with DOD and industry R&D, has laid the foundation for the world's leading military and civilian aircraft industries, and for advances in a great many component technologies. Moreover, NASA's R&D in aeronautics benefits the public broadly, through improvements in aircraft performance, safety, and comfort, and reduction of noise and pollution.

Defense R&D, both within DOD labs and in industry, has been a powerful force for advances in aeronautical technology. DOD labs are also strong contributors to space technology, and DOE labs have at times played an important part. For example, the small,

inexpensive, and elegant scientific spacecraft *Clementine* embodied technologies from both DOD and DOE labs as well as NASA.

Barriers to Efficiency and Effectiveness of Laboratory Contributions

While the contributions of the three largest federal laboratory systems to national needs are important and diverse, serious barriers stand in the way of their making those contributions efficiently and effectively. This is of particular concern when budgets must be constrained in the interest of federal deficit reduction. Major problems may be summarized as follows:

o Serious management flaws at the agency level deprive the laboratory systems of the efficiency they must have in meeting national needs, especially in a time of fiscal stringency. Some aggressive moves by agencies are underway to improve management.

o All three systems, born and operated for most of their lives in the Cold War, must now be downsized and restructured. Much of this could be done in ways that preserve or improve their service to the Nation, through better management, clear definition of missions for individual labs, and elimination of needless redundancies.

o Improved management will yield some but not all of the savings necessary to reach the budget goals for the parent agencies of the laboratories -- especially DOE and NASA -- over the next 5 years. Tough choices must be made and priorities set even among highly productive programs. It is a challenging task to achieve adequate funding for high-priority science and technology programs -- in the areas of fundamental science, national security, environmental science and technology, and applied research in conservation and clean and renewable energy -- as well as necessary investments in the space station and funding for legally mandated environmental cleanup. Lower priority areas of current research will have to be eliminated, consolidated, or possibly devolved to other agencies. Coordinated planning, inside the government and together with other R&D performers such as industry and universities, will be essential for meeting high priority national goals.

o Environmental cleanup and restoration are large, growing, and hugely expensive responsibilities for DOE and DOD. DOE in particular is faced with legal commitments to clean up the half-century legacy of pollution created by the nuclear weapons production complex. However, in many cases adequate cleanup technologies, and the scientific understanding on which they must be based, do not exist. The labs, together with other performers, are involved and could play a greater part in advancing the science and technology of environmental remediation. To take advantage of this potential, it will be necessary both to greatly improve and integrate R&D for environmental cleanup, from basic science to engineering applications, and to modify unrealistic and unfeasible requirements in cleanup agreements and the law.

o Staff quality and creative capacity are critical at all of the labs. Inflexible civil service

rules make it difficult for the DOD and NASA laboratories -- which are government-owned and -operated -- to maintain or build staff quality while downsizing.

o Coordination among NASA, DOD, and the industry in aerospace R&D and in the closure of redundant facilities is not adequate to the task. Stronger joint planning is necessary to achieve efficiencies and cost savings.

o Agencies managing the laboratory systems -- and lab directors as well -- must guard against an institutional tendency to use scarcer R&D funds in house. Maintaining a proper balance among a particular agency's labs, other federal labs, universities, industrial labs, and other performers, is essential. Extensive external peer review of research, and disinterested evaluation of various performers' strength in technology, can help to preserve or attain the right balance.

o In DOD's recommendations for its laboratories in the 1995 round of the Base Realignment and Closure (BRAC) process, little progress was made in cross-service integration, and downsizing was modest. Further work by DOD is needed toward efficient restructuring of its labs and integration of R&D capabilities and facilities across the services.

o Further work by DOD, DOE, NASA, and the appropriate NSTC Committees is necessary to identify areas for cooperative relationships among the three laboratory systems, and between these systems and research groups elsewhere in the federal government.

RECOMMENDATIONS

I. Improving Management and Cutting Redundancy

Both DOE and NASA have management problems that must be repaired if they are to reduce the costs of their laboratory system and operate them more effectively. Both agencies are working to correct agency overstaffing and to make appropriate and necessary reductions in the size of their laboratory systems. These laboratories will serve the Nation better and at less cost with improved management by parent agencies, elimination of needless redundancies, and clearer, more focused mission assignments both for individual labs and for the labs as systems. Excessive agency oversight and micromanagement of laboratories is a particular problem for DOE. DOE and NASA agree with these assessments, and have already begun constructive steps to solve the problems.

Management of DOD labs -- as separate systems within each of the military services and departments -- is generally effective. For the most part, missions of the labs are distinct, and reasonable authority is in the hands of directors with little micromanagement. However, the opportunity offered by the BRAC process to achieve greater efficiencies through cross-service integration was largely missed. And the downsizing of labs that DOD proposed in the 1995 BRAC round (the last under present law) was modest.

A. DOE Laboratories

The existing system of DOE governance of its labs needs fundamental repair. The government-owned, contractor-operated system that once offered flexibility and freedom from red tape has become burdened with orders, directives, and proliferating audits and reviews, with the result that the labs' scientific and technical work is under serious stress. These burdens have increased markedly over the past 15 years, driven by overly prescriptive Congressional management and excessive DOE oversight.

Moreover, the DOE laboratory system is bigger and more expensive than it needs to be to meet its essential missions in energy, environment, national security, and fundamental science. This results in part from the management flaws described above. In part, it reflects political considerations that inhibit lab consolidations and restructuring. And in part, it arises from redundancy and lack of clarity in mission assignments. Some redundancies are desirable; following different lines of inquiry in both science and technology can often be very productive. However, there is excessive duplication of capabilities among the labs. It appears that each lab is trying to keep open as many options as possible in a broad range of science and technology fields. Missions of the labs must be clarified and focused on their primary -- and a few secondary -- areas of excellence so that the labs operate more efficiently and effectively as a system.

DOE agrees that agency management of the labs must be repaired, and is taking aggressive steps to do so. However, the prescription of the Galvin Task Force, which is to "corporatize" the DOE labs on a private sector model, raises significant concerns about accountability for the spending of public funds, and would require Congress to cede a substantial measure of authority over federal R&D funding. It is also possible that the approach could deflect the labs from long-term strategic research into a "job shop" mentality -- a concern raised by the Galvin Task Force itself and reiterated by DOE. To proceed along the path of corporatization would require much more specificity to answer the concerns that have been raised, especially on accountability for public funds. However, DOE has pledged to keep possibilities for fundamental changes in DOE lab governance open while aggressively pursuing immediate improvements in its management of the labs.

The Department is attacking its lab managment problems in three ways:

o Drastically reducing and simplifying orders; limiting DOE reviews and audits of the labs; reforming procurement to "commercial best practice"; and, insofar as possible, handing off to external agencies (EPA, OSHA, NRC) health, safety, and environmental regulation of the labs.

o Realigning DOE's management structure and downsizing its federal employment levels by 3,788 (27 percent) over five years, from a base of 13,900 in fiscal year 1995. This includes a staff reduction of 2,338 (34 percent) from a base of 6,850 at headquarters and 1,450 (21 percent) from a base of 7,047 at the Department's field offices, which devote much of their staff effort to overseeing the orders, directives, and audits that are to be drastically simplified.

o Establishing a Laboratory Operations Board, chaired by the Under Secretary. The 16-member Board will be composed of eight senior management officials of the Department and eight external members selected from industry and academia. The external members are constituted as a standing panel of the Secretary of Energy Advisory Board. The Laboratory Operations Board will help provide strategic direction for the labs, monitor the progress in improving DOE management and oversight of the labs, and help provide sharper mission focus and coordination among the labs.

Recommendations

DOE will vigorously pursue its current activities to improve management of its labs, as demonstrated through prompt establishment of the Laboratory Operations Board. In addition, DOE will explore with others in the Administration (including the Office of Management and Budget and the Office of Science and Technology Policy) whether statutory direction would enhance the authorities and responsibilities of the Laboratory Operations Board, and whether

some or all of the external Board members might eventually be appointed by the President.

To document its progress, DOE will submit a report to the President on its management improvement, including management staff reductions, agency realignment, regulatory streamlining, and progress toward goals for reducing orders, audits, and excessive oversight; mission definition for the DOE labs; and the initial phases in restructuring of the laboratory system for greater efficiency, by February 15, 1996. The plan will include a schedule for any necessary downsizing. The advice of private sector members of the Laboratory Operations Board will be reflected in the reports.

B. NASA Centers

NASA has achieved success in the recent past in removing management layers and inefficiencies. Administrator Goldin's commitment to "faster, better, cheaper" ways of accomplishing NASA's missions has shown results; for example, the international Space Station was redesigned to cost $17.4 billion instead of $25.1 billion.

However, there are still more people than necessary at headquarters, and there is lack of clear mission focus, leading to redundant capabilities, at the NASA Centers. Inefficiency also arises from duplication of aerospace facilities among NASA, DOD, and private industry.

NASA agrees with this assessment. NASA has already adopted one recommendation of the Foster Task Force, scrapping a custom-made financial management information plan that was under development and adopting instead an off-the-shelf commercial system. NASA will also:

- Clarify and focus missions of NASA Centers, reduce lab staff accordingly, and assign management of NASA programs to the Center with the lead responsibility for the relevant mission.

- Remove management of those programs from headquarters, retaining headquarters management only of multi-center programs, including the international Space Station and the Space Shuttle, and overall guidance of NASA's five Strategic Enterprises; headquarters staff will be reduced accordingly.

- Cooperate closely with DOD and industry in identifying redundant aeronautical and space facilities, in addition to those found in the National Facilities Study; cooperate with DOD in closure and consolidation of excess space and aeronautical facilities.

In May 1995 Administrator Goldin announced proposals from an internal NASA review team, detailing plans for sweeping organizational and management changes that will cut the

agency's budget from $14.5 billion today to $13 billion in 2000, and will reduce civil service and contractor employment by nearly 29,000. The proposals are designed to reduce jobs, facilities, and administrative overhead rather than terminating core science, aeronautics, and exploration programs -- an approach consistent with recommendations of the Foster Task Force.

The Foster Task Force found that NASA's one large contractor-operated research facility, the Jet Propulsion Laboratory at the California Institute of Technology, is burdened with detailed task orders and excessive oversight, somewhat analogous to the situation at the DOE labs. Although NASA disagrees with this finding, it is taking the charge seriously and investigating it with an open mind.

Recommendations

NASA will submit a report to the President by February 15, 1996 on progress in focusing missions for Centers, delegating program responsibility to Centers, cutting excess staff at headquarters and Centers. The report will include numerical targets and a schedule for reduction in headquarters and agency staff.

NASA will promptly review its oversight of the Jet Propulsion Laboratory and take immediate steps to remove excessive oversight burdens.

NASA will also explore possiblities for putting some of its Centers, or possibly parts of them, under management by a university or consortium of universities. Coupling NASA research capabilities more closely with the intellectual resources of an outstanding university could help to retain and build the Centers' technical and scientific strength. Although the system of managing labs by contract with universities is now under a cloud because of the micromanagement and the excessive oversight burdens imposed by parent agencies, reforms underway by DOE and NASA could restore luster to the idea.

C. <u>DOD Laboratories</u>

DOD's guidance for Round Three of the BRAC process emphasized the importance of cross-service integration and maximum use of common support assets. Opportunities for cross-service integration within DOD laboratories are greatest in areas where each of the services has both requirements and existing laboratory programs. The most promising areas are: biomedical R&D, energetics (explosives, propellants, and pyrotechnics), C^4I, and common facilities in all aspects of research, development, testing, and evaluation for aircraft and air-to-air and air-to-ground weapons.

DOD's BRAC 95 recommendations made only limited progress toward the goal of cross-service integration. The most significant change was the decision to form the tri-service Armed Forces Medical Research and Development Agency. In addition, a degree of cross-

service integration will be achieved in the closure of the Air Force's Rome Laboratory in New York State, by moving some electronics, computer, and communications work, with staff, to the Army's Fort Monmouth facility in New Jersey. Significant proposals for cross-service integration in the other areas, however, were lacking in the BRAC recommendations.

DOD's recommendations for closing labs were on the whole modest. The Air Force proposed moving two labs and consolidating components of each, with consequent savings in operations costs, but would retain and transfer most of the positions. The Army's proposal would reduce some administrative positions, but would neither close any labs nor remove any lab staff. The Navy, which has the largest lab structure, proposed the most considerable changes, recommending the closure of a number of facilities and substantial reduction of lab staff positions.

Although DOD did not take the opportunity provided by BRAC to integrate more functions across the services, achieving integration by other routes is a possibility for the future. Downsizing of DOD labs is a necessity, because of declining budgets and reduced mission demands resulting from fewer acquisitions, and because of the Department's obligations to reduce staff, as part of the reduction in federal employment mandated by the President and by law. In line with the mandate for personnel reduction, the military departments are planning to cut lab staff (Full Time Equivalent, or FTE) by 35 percent from 1994 through 2001. The greater efficiency achieved through cross-service integration will be necessary to continue meeting mission requirements while budgets and the size of lab staff shrink.

In forwarding BRAC 95 recommendations, Secretary of Defense William Perry said: "Overall, the cross service effort did assist in reducing capacity and determining where joint or collocated functions made functional or economic sense. Further, this DOD-wide review of support functions provides a road map for cross-servicing in the future."

Recommendation

DOD will submit a report to the President by February 15, 1996 detailing plans and schedules for downsizing the DOD laboratories, including identification of opportunities for greater efficiency through measures such as cross-service integration and service lab consolidations.

D. Maintaining Staff Quality and Creativity

All three lab systems are faced with the necessity of downsizing, as lab missions are focused more sharply and unnecessary duplication is eliminated. The contractor-operated DOE labs, and NASA's contractor-operated Jet Propulsion Laboratory (JPL), have more flexibility to downsize in ways that allow selective layoffs and fresh new hires. DOD labs and most NASA labs are constrained by Civil Service rules, which permit much less flexibility.

Both NASA and DOD face large potential problems in cutting employment at labs while maintaining or improving staff quality. For example, DOD plans to cut lab employment by about 35 percent from 1994 to 2001. Attrition alone could accomplish this cut, but at the cost of loss of experience coupled with no new hires. DOD regards the staffing problem as crucial.

Experiments have shown that the problem can be handled. DOD has a demonstration project, now 15 years old, at the Navy's China Lake weapons center. It allows the Navy latitude to modify federal Civil Service hiring and job classification rules in order to get and keep good scientists and engineers. Widely regarded as successful, the China Lake project was the model for the personnel system adopted by the National Institute of Standards and Technology, and for several initiatives in the Federal Employee Pay Comparability Act of 1990. In the FY 95 Authorization Act for DOD, Congress removed the time limits on the China Lake experiment and authorized DOD to conduct more China Lake-type demonstrations.

Several DOD labs have proposed plans for the demonstrations. They include flexible pay scales, based on performance; flexible position descriptions; ability to hire without going through formal competition; flexibility in choosing whom to offer early-out bonuses; and ability to choose people for Reductions in Force based on performance, not strictly on seniority.

There is further flexibility in the Civil Service Act itself. The Office of Personnel Management may conduct large-scale demonstration projects of the China Lake type, covering up to 5,000 people for 5 years. There are conditions: OPM may conduct no more than 10 demonstrations at a time (two are underway); OPM must notify both Houses of Congress twice before starting a project; and a formal evaluation is required.

Recommended Actions

DOD will carry out the plans it has developed for China Lake type demonstration projects at its laboratories. NASA will work with OPM to develop demonstration plans to handle some of its anticipated reductions in staff and to improve the efficiency of its operations.

The Administration will evaluate results of these and earlier projects and will work with the Congress for necessary changes in the law to allow greater flexibility in personnel policies for scientific and technical staff at research institutions.

II. Modernizing the Laboratories for the Post-Cold War Era

A. <u>The Nuclear Weapons Responsibility</u>

Most of DOE's large multi-program laboratories had their origin in the Manhattan Project, to develop nuclear weapons during and after World War II. The three largest

laboratories in the system -- Lawrence Livermore, Los Alamos, and Sandia National Laboratories -- have remained the main locus for the design and development of nuclear weapons.

The end of the Cold War has brought great change. No new nuclear weapons are being designed in the United States, and this country is working with other nations to conclude a Comprehensive Test Ban Treaty and a Fissile Materials Production Ban, and has achieved the indefinite extension of the Non-Proliferation Treaty. The major responsibilities for DOE's nuclear weapons program today and into the next century are:

- o to ensure the safety, reliability and security of the Nation's nuclear weapons stockpile, in the absence of nuclear testing;

- o to provide technical support in the areas of non-proliferation, counter-proliferation, verification, and intelligence.

As part of the safety, reliability, and security program, the laboratories may become more involved in some aspects of materials and components production and remanufacture of stockpiled weapons. DOE has already closed some of its large-scale nuclear weapons production facilities and may close others, with transfer of much smaller scale production operations to the weapons labs.

Over the many years that the United States was in direct military competition with the Soviet Union, two DOE laboratories -- Los Alamos and Lawrence Livermore -- were responsible for the design of the nuclear warhead in a system of competition, peer review, and planned redundancy. Sandia's job was to integrate the warheads into a weapons system. Today, all three labs are involved in DOE's science-based stockpile stewardship program, the approach chosen by DOE to ensure safety, reliability, and security, without nuclear testing, of the enduring stockpile after START I and START II reductions.

Since the dissolution of the Soviet Union, spending for core nuclear weapons activities at the three weapons labs has dropped substantially, and staff levels for these core activities are about half what they were at their peak in the 1980s. However, these laboratories also carry out R&D for other DOE programs and other federal agencies. The total employment and budgets, for all activities at the weapons labs, have declined far less from the mid-1980s peak. In constant dollars, total budgets for the three weapons labs were still one-fourth higher in 1995 than they were in 1979; much of that increase comes from work for agencies other than DOE.

The Galvin Task Force concluded that the labs possess excess capacity in areas associated with nuclear weapons design and development; that many of these activities would be transferred, as cost-efficiency allows, from Lawrence Livermore to Los Alamos; and that alternative approaches should be explored for peer review of safety and reliability issues within

an aging stockpile. Lawrence Livermore would retain its current responsibilities for non-proliferation, arms control, and related work.

Other experts hold a contrary opinion. A national security advisory panel to the President of the University of California (the contractor that operates Lawrence Livermore and Los Alamos) recommended that Lawrence Livermore retain its weapons design capability for approximately ten years and continue during this period to provide peer review for the science-based stockpile stewardship program.[1] The argument is that the scientific basis for assuring safety and reliability of the stockpile, without nuclear testing, is not yet well developed. Indeed, there remains considerable technical debate over the kinds of non-explosive testing and evaluation that are most needed.

Another factor is that DOE has taken the first major step toward building a very high power laser, the National Ignition Facility (NIF), at Lawrence Livermore.[2] Through physics experiments involving extremely high temperatures in condensed matter, the NIF can help to maintain expertise in an area of experimental physics fundamental to nuclear weapons design. It can also make important contributions to astrophysics and science generally, and it could help to attract the bright scientific minds that are essential to the science-based stewardship program. A decision to proceed with construction of the NIF is scheduled to be made with the FY 1998 budget, following reviews of non-proliferation and environmental issues. Current estimates are $1.1 billion for construction of the NIF, and $115 million per year for operation, maintenance, and research activities. The Galvin Task Force recommended proceeding with the NIF as a research facility, prioritized with respect to other major research activities.

Budget constraints are a driving force in decisions on eliminating redundancy and restructuring the weapons labs for the post-Cold War era. The Galvin Task Force recommendation favored measured withdrawal (over "several years" in some cases, "five years" in others) of Lawrence Livermore from many weapons activities, largely because it felt redundancy is no longer justifiable. Another way of looking at the budget issue is that, given constrained resources, one lab with the primary weapons design capability could more easily be funded at a robust level than two.

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[1] Letter to Dr. Jack Peltason, President, University of California, from Sidney D. Drell, Chairman, National Security Panel of the U.C. President's Council on the National Laboratories, dated February 16, 1995. All but one of the members of the Panel supported this recommendation. The member who disagreed was a member of the Galvin Task Force.

[2] In October 1994, Secretary of Energy Hazel O'Leary approved Key Decision-1 for the NIF, which authorizes engineering design studies, conditional on the results of a study of proliferation implications of the NIF.

DOE has expressed an "initial favorable disposition" for considering a careful phase-down of some of Livermore's nuclear weapons work, combined with a re-emphasis on non-proliferation and related activities. However, the timing and details of proceeding down this path must depend on assessments of how best to meet our continuing national defense requirements in a wholly new era, the Department said. DOE is examining options, including the Galvin Task Force recommendations, for changes in the configuration of activities at its weapons laboratories.

Recommendations

The serious disagreement among very able and knowledgeable people on whether two nuclear weapons design centers are needed should be resolved.

DOE will develop detailed recommendations for possible changes in configuration of nuclear-weapons-related activities among the three weapons labs, taking into consideration the recommendations of the Galvin Task Force. These recommendations shall be considered by an interagency working group chaired by DOE and including (although not necessarily limited to) DOD, the Department of State, the Office of the Vice President, the staff of the NSC, OMB, OSTP, and the Arms Control and Disarmament Agency. Calling on outside experts as needed, the interagency working group will, by September 30, 1995, address and produce recommendations for resolution of the following issues:

o In order to assure the safety and reliability of the nuclear stockpile in the absence of nuclear testing -- and the security interests of the Nation -- what is our best projection of the functions and capabilities that should be maintained at Lawrence Livermore? Can the essential scientific expertise be maintained in a less costly fashion? The analysis will include a discussion of the comparative costs of keeping two nuclear weapons design centers in full operation at two labs, compared to moving toward one.

o What alternative primary mission or missions (e.g., fundamental science, applied energy programs in conservation and renewables, environmental science and technology) might take advantage, in an efficient and productive manner, of the laboratory's outstanding human talents and facilities? The analysis will also examine the relationship between Lawrence Livermore's mission(s) and a decision on whether to build the National Ignition Facility at Lawrence Livermore.

Recommendations on these issues will be coordinated with the NSC Interagency Working Group, pursuant to its annual review of the stockpile stewardship program. The two reviews shall be considered together, if necessary by a joint NSTC/NSC process, to arrive at recommendations to the President by October 31, 1995.

B. <u>Coordinating Management of Facilities and Capabilities for Aerospace R&D</u>

With the decline in procurement of military weapons systems since the end of the Cold War, DOD is not funding the diversity of new approaches to aircraft design that it did in the past. This affects civilian as well as military aeronautics. Civil aeronautics has long benefited from technology advances in military aircraft, and the reverse is true as well. Although there are many differences in critical elements for military and civilian aircraft -- probably more today than in earlier times -- there is still substantial synergy.

Overall, sources of funding for the traditional interactions between DOD, NASA, and private industry R&D in aeronautics have declined. Both the Foster Task Force report on NASA labs and the DOD lab report found a need for better coordination of research, development, testing, and evaluation (RDT&E) programs for aeronautics, and coordinated management of critical aeronautical facilities, taking into account the contributions of DOD, NASA, and the industry. In addition, the Administration is currently working with industry to determine the national need and priority for new wind tunnel facilities, within constrained RDT&E budgets.

Further coordination of space programs between DOD and NASA is also needed to identify excessive duplication in facilities, capabilities, and programs that might present opportunities for further effiencies through elimination, consolidation, or joint management and operation.

Recommendations

NASA and DOD, working with other appropriate government agencies and building on the 1994 National Facilities Study, will conduct a case-by-case review of their aeronautical and space facilities and capabilities and identify areas of overlap where additional efficiencies and effectiveness could be achieved through shared resource investment and joint facility management. An interim report on these activities will be submitted to NSTC by February 15, 1996. A joint implementation plan will be submitted to the Assistant to the President for National Security Affairs and the Assistant to the President for Science and Technology by June 30, 1996, detailing how cross-agency RDT&E consolidations, joint management of facilities, facility closings, and other efficiencies will be achieved.

Recognizing recommendations contained in the National Facilities Study, the National Research Council report on the proposed National Wind Tunnel Complex, and the Foster Task Force report, NASA and DOD, working in concert with industry, will conduct a special assessment of wind tunnel facilities and capabilities. This study will investigate opportunities for interagency cooperation, assess the priority of wind tunnel investments within current overall budget constraints for aeronautics RDT&E, and define the impact of new subsonic and transonic wind tunnels on the current infrastructure. Recommendations will be submitted in a joint NASA/DOD report to the Assistant to the President for National Secrutiy Affairs and the

Assistant to the President for Science and Technology by November 15, 1995.

III. Supporting High Priority Basic and Applied Research

As noted above, both DOE and NASA play extremely important roles in the nation's overall program of fundamental science, with very significant contributions from their laboratories. DOD's support of fundamental science is also essential, especially for university research in fields such as mathematics and computer science. The DOD lab's role, while important, is directed more specifically to national security purposes than to a general expansion of scientific knowledge.

All three agencies are also crucially important contributors to applied research within their mission areas. At NASA, applied research and development of space technology is a central activity. Although NASA is not the only R&D performer in this area -- DOD, DOE, and private industry are also key players -- NASA applied research is an essential element in the agency's mission of space exploration, and contributes to the performance of the private space industry as well.

DOE's applied energy programs -- in energy efficiency, conservation, and renewable energy -- are high priority items on the national research agenda. DOE and its labs also have special responsibilities for ongoing applied research in nuclear energy. In these mission-related areas, it is neither possible nor desirable to make a hard and fast distinction between basic and applied research. In fact, greater integration between DOE's various applied and fundamental energy R&D programs, and between basic and applied environmental research, is essential. This is just as true of research conducted by other performers as for the research done within DOE labs.

DOD is a major contributor to many critical areas of applied research with direct application to military needs, especially in microelectronics, electronic systems and components, computers and telecommunications devices, advanced materials and advanced manufacturing. Some of this work is done in DOD labs, though most is outsourced to other performers.

Fundamental science and high-priority applied research face tough competition in a time of tight budget constraints. Agencies must squarely face the necessity to cut lower priority programs in favor of the most essential ones. Even so, adequate funding for these programs will be hard to find, and will require careful planning and co-venturing, often in conjunction with other federal agencies, academia (especially for basic research), and industry (especially for applied research).

Recommendation

In adjusting to tighter budgets, DOE, NASA, and DOD must preserve adequate funding for high priority programs in basic and applied research. To protect these programs, they will first achieve all possible savings through streamlining and improving management. Then, as necessary, they will reduce or eliminate lower priority programs, in accordance with guidance from the Office of Management and Budget and Office of Science and Technology Policy, based on priorities set by the National Science and Technology Council and, as appropriate, the National Security Council. Equal cuts across the board, affecting high and low priority programs alike, are not acceptable.

IV. Improving Environmental Remediation

DOD, DOE, and NASA all have significant responsibilities and capabilities in environmental protection and cleanup. A particularly urgent problem for both DOE and DOD is their obligation to deal with the legacy of past pollution. Environmental cleanup and reclamation is now DOE's largest program, totaling over $6.5 billion a year, including R&D. DOD is spending about $2 billion a year on cleanup, another $2 billion on complying with controls over emission of pollutants, roughly $500 million on environmental R&D (not restricted to R&D for cleanup), and an additional $500 million on pollution prevention and conservation.

DOE's environmental problems are even greater than DOD's. The dilemma is that DOE is legally committed by compliance agreements that the previous Administration signed, in an attempt to redress past neglect, but which have led to a costly, unrealistic cleanup schedule using technologies that are often ineffective. DOE is renegotiating some of these agreements, but is still bound by most of them. It is also burdened by public distrust, a legacy of the past neglect by DOE and its predecessors of their responsibility for protecting the public from radioactive and chemical hazards. A further inheritance is a very large contractor work force and inefficient management of the cleanup task.

DOE is making some progress toward leaner staffing and more efficient management. DOE plans call for reducing the work force at the major cleanup sites by 15 percent (about 15,700 out of 107,300 full time employee positions at contractor-operated facilities) from the end of 1994 to year's end 1996. Further reductions can be carried out; headquarters and site managers should continue and expand their efforts for greater efficiency. But fundamentally, better scientific understanding and new technologies are needed for a more effective and less costly program. Developing these will take time, better integration of research with applications between the Energy Research and Environmental Management programs within DOE, and tighter coordination of R&D with other agencies -- in particular, DOD, EPA, the Bureau of Mines (USBM), and the National Institute for Environmental Science and Health (NIESH).

DOE has also made a start on better integration. Cross-agency planning sessions are underway to link fundamental research with new approaches to cleanup technology. Also, DOE has a formal means of coordinating environmental R&D with DOD and other agencies;

however, closer ties between DOE, EPA, USBM, and NIESH should receive more attention. Most important, DOE is still bound by existing compliance agreements and the law to a cleanup schedule that almost mandates high-cost low-yield cleanup efforts.

Recommendations

DOE will take the lead in creating a strategic plan for scientific research linked with technological applications for environmental remediation at DOE sites. The plan will explicitly link DOE's basic research with applications, but will also include research and development funded by the National Science Foundation (through its grants program), DOD, EPA, USBM, and NIESH. The DOE labs can make a unique contribution to the cleanup plan, through their specialized knowledge of nuclear materials and the pollution control and cleanup problems specific to them. However, DOE must also be free to assign R&D projects to the best performers, whether in the DOE labs, other federal research facilities, academia, or industry. This is not a new entitlement for the labs. Their contributions must be measured against those of other performers, with research awards determined solely by quality, through competitive selection.

Both DOE and DOD will continue and expand programs designed to test and evaluate innovative remediation technologies using agency facilities as testbeds. DOE's Integrated Demonstrations project establishes and validates remediation technologies as a system; this successful project should be continued with more emphasis on verification. DOD's testing sites have been extremely important in helping to develop new technologies; additional testing sites should be made available.

In combination with the strategic planning by the agencies, the Administration will work with Congress to enact improved Superfund legislation, as proposed by the Administration in 1994. The Administration will also work with the Congress to develop sound risk assessment legislation that eliminates counter-productive over-regulation while preserving the essential goals of protecting the environment and public health. Improved R&D and a revised statutory framework are both essential for enabling DOE, DOD, and private industry to carry out an efficient, effective program of environmental cleanup.

V. Areas for Further Review

The three individual agency reviews that are the foundation for the Interagency Federal Laboratory Review all considered the capabilities of the lab system under review to meet the national needs identified in PRD/NSTC-1. With the exception of aerospace RDT&E, these individual reviews did not try to identify specific duplications or significant gaps either among the programs of the three agencies, or between their laboratories and other performers (i.e., comparative advantage).

However, the DOD review did address the subject quite specifically in the context of national security. DOD convened panels of government and private sector experts to consider twelve science, technology, and engineering functions that DOD requires for its national security mission, and evaluate which are best served, or uniquely served, by DOD labs, and which could be better served by other performers. As noted, the panels concluded that there are few if any technical constraints to other performers conducting R&D for the military, but that institutional reasons argue strongly for maintaining a quality DOD lab system. However, the panels also found opportunities for further outsourcing in many of the areas studied.

Overlap and unnecessary redundancy between the three big laboratory systems and other federal R&D facilities remain to be explored in a broader way. Redundancies may exist in a number of important fields, especially between the wide-ranging multipurpose DOE labs and other federal institutions; for example, in materials research, with NASA and DOD; in earth sciences research, with USBM and the U.S. Geological Survey; or in forest products research with the Department of Agriculture. As noted before, some redundancy is desirable or positively necessary -- certainly at the frontiers of science and often for complex technological problems as well. But in the face of severe budget constraints, careful examination of possibly excessive duplication of research among different federal lab systems is needed.

Neither the Galvin nor the Foster Task Force proposed closure of specific labs. Both concluded that the agency with management responsibility could and should make decisions. They also recognized that such decisions might well be necessary, to eliminate redundancies in the most efficient manner. DOD did propose some lab closures, in connection with the BRAC (Base Realignment and Closure) process, but did not fully exploit the opportunities, either for cross-service integration or for downsizing. Further reductions will be necessary in the future.

Indeed, this review of federal laboratory systems is not an end point, but part of a continuing process. Agencies must continue to examine all options for achieving further efficiencies. In particular, after the agencies digest their current efforts to improve management, refocus the missions of their laboratories, and eliminate redundancies, it will be time for a closer look at redundancies across agencies as well as within agencies, and across military services.

The approach outlined here relies on parent agencies of the laboratories taking numerous actions, quickly and effectively, to make the needed improvements. The approach is not to do one or two big things but to do dozens of smaller but very important things that collectively result in major change. Reports from agencies due by mid-February 1996 will show whether this approach is yielding progress toward measurable results. If not, it may be necessary to consider more fundamental changes in the management of the government's largest laboratory systems.

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